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ED 012 147 FL 000 266

A COMPARISON OF SYLLABLE LENGTH CONDITIONING AMONG LANGUAGES.

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PUB DATE SEP 66

EDRS PRICE MF-$0.09 HC-$0.80 20P.

DESCRIPTORS- *LANGUAGE RESEARCH, *PHONETIC ANALYSIS, *PHONETIC STRESS, *STATISTICAL DATA, *CONSTRASTIVE LINGUISTICS, FRENCH, SPANISH, ENGLISH, GERMAN,

A COMPARISON OF ENGLISH, GERMAN, SPANISH, AND FRENCH SYLLABLE-LENGTH DATA SHOWS THAT THE EFFECT OF STRESS AND OF PLACE IN THE SENSE-GROUP VARIES MARKEDLY AMONG THESE LANGUAGES, WHEREAS THE EFFECT OF SYLLABLE TYPE (CLOSED/OPEN) HAS A NEARLY IDENTICAL RATIO IN ALL FOUR. AMONG THE THREE LANGUAGES WITH VARIABLE INTENSITY AND PLACE OF STRESS, THE DIFFERENCES OF LENGTH BETWEEN STRESSED AND UNSTRESSED SYLLABLES ARE ALWAYS THE WIDEST IN ENGLISH, AND THE NARROWEST IN SPANISH, WITH GERMAN INTERMEDIARY. THE SAME CAN BE SAID OF DIFFERENCES OF LENGTH BETWEEN FINAL AND NONFINAL SYLLABLES. VOWEL INTENSITY VARIATIONS CORRELATE WITH SYLLABLE LENGTH VARIATIONS IN ENGLISH, GERMAN, AND SPANISH, BUT NOT IN FRENCH, WHERE THE VOWEL OF A FINAL STRESSED SYLLABLE IS SOMEWHAT LESS INTENSE THAN THAT OF A NONFINAL UNSTRESSED ONE. IN THE THREE LANGUAGES WITH VARIABLE PLACE OF STRESS. FINAL UNSTRESSED SYLLABLES ARE, ON THE AVERAGE, AS LONG AS--BUT LESS LOUD THAN--NONFINAL STRESSED ONES. (STATISTICAL DATA ARE PRESENTED IN 18 TABLES AND ONE FIGURE.) THIS ARTICLE WAS PUBLISHED IN THE "INTERNATIONAL REVIEW OF APPLIED LINGUISTICS IN LANGUAGE TEACHING," VOLUME 4, NUMBER 3, SEPTEMBER 1966. (AUTHOR)

ED012147

A COMPARISON OF SYLLABLE LENGTH CONDITIONING AMONG LANGUAGES [1])

Pierre Delattre

La comparaison de la durée des syllabes en anglais, allemand, espagnol et français est présentée en 18 tableaux et une figure. Ces tableaux montrent que l'effet de l'accent et de la place de la syllabe dans le groupe de sens varie considérablement d'une langue à l'autre, tandis que l'effet du type de syllabe (ouverte/fermée) a un rapport semblable dans toutes les langues. Parmi les trois langues à intensité et à place d'accent variables, les différences de durée entre syllabes accentuées et syllabes inaccentuées sont le plus étendues en anglais, le moins en espagnol, et l'allemand est intermédiaire. On peut en dire autant des différences de durée entre syllabes finales et non-finales. Il existe une corrélation entre les variations d'intensité vocalique et les variations de durée syllabique en anglais, en allemand et en espagnol, mais pas en français, où la voyelle d'une syllabe finale (accentuée) est en moyenne légèrement moins intense que celle d'une syllabe non-finale (inaccentuée). Dans les trois langues où la place de l'accent varie, les syllabes inaccentuées sont en moyenne aussi longues – mais moins fortes – que les syllabes accentuées non-finales.

Achtzehn Tabellen und eine Abbildung zeigen die Ergebnisse eines Vergleiches von englischen, deutschen, spanischen und französischen Silbenlängen. Die Tabellen machen klar, daß in diesen Sprachen der Einfluß von Betonung und Position innerhalb einer Sinneinheit sehr unterschiedlich ist, während der Einfluß der Silbenart (offen oder geschlossen) dieselben Unterschiede in allen aufweist. In den drei Sprachen, deren Betonung und Intensität Variierungen unterworfen sind, zeigt das Englische immer den größten Längenunterschied zwischen betonten und unbetonten Silben und das Spanische den geringsten, während das Deutsche sich in der Mitte befindet. Dasselbe kann über den Unterschied zwischen nicht-finalen und finalen Silben gesagt werden. Vokalintensität-Variierungen stehen im Englischen, Deutschen und Spanischen in direkter Beziehung zu Silbenlängen-Variierungen, was im Französischen nicht der Fall ist, da der Vokal einer betonten Endsilbe oft weniger Intensität aufweist als der Vokal einer unbetonten nicht-finalen Silbe. In den drei Sprachen deutsch, englisch und spanisch sind die unbetonten Silben im Durchschnitt ebenso lang – aber nicht so laut – wie nicht-finale betonte Silben.

Relative length is one of the elements which determine the perceptual "weight" of a syllable and give it prominence.

As a first step towards comparing the distribution of syllable weight in English, German, Spanish, and French, we are investigating the length of

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[1]) The research reported herein was performed pursuant to a contract with the United States Office of Education, Department of Health, Education, and Welfare.

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syllables in those languages and the factors which correlate with and condition this length.

It is generally believed that in the perception of syllable weight, three subjective ingredients may play a part – loudness, pitch, and length. The reason for beginning this investigation with length is that it is relatively simple – measurements of duration can yield clear figures. The other factors of syllable weight offer such complexity that it was thought better to postpone comparing their relation to syllable weight among languages until duration was sufficiently understood. The contribution of pitch to syllable weight may depend, for instance, not only on the average frequency of one syllable relative to others, but on the contour of this frequency variation, its rise, its fall, its proportion of fall and rise. The contribution of loudness to syllable weight may depend not only on vowel intensity (or overall amplitude) and its onset and decay, but on certain features of the consonants such as the length of closure and the speed of opening which are not measurable in decibels, yet depend on the energy expended.

To avoid obscuring the results of our measurements, we shall limit this investigation, for the most part, to three conditioning factors – syllable weight, syllable position and syllable type – and we shall consider them only as binary factors. Thus, in matters of weight, syllables which receive a primary stress will be called "stressed" and all others will be called "unstressed"; in matters of position, syllables which stand last in sense-groups will be called "final"; and all others will be called "non-final"; and in matters of type, syllables which end with one or more consonant sounds will be called "closed" and all others will be called "open".

Before comparing syllable lengths and length-conditioning among the four languages mentioned above, let us describe briefly the experimental procedure which was followed in gathering appropriate syllable-length data.

For each of the four languages, five minutes of extemporaneous speech by native speakers was selected with the purpose of obtaining naturalness and fluency in expression with relatively similar speeds of delivery. Spectrograms of the material were made at the scale 2000 cps per inch, with narrow-band filtering and amplitude display.

By referring to both the original recordings and the spectrograms, a broad phonetic transcription was made, stressed syllables were identified, and sense-group boundaries were determined.

Then the difficult matter of syllable division was approached. It raised two obstacles: a) dividing syllables had to be uniform for all languages, yet certain characteristics of each language had to be taken into account; b) scientifically speaking, syllabic division generally occurs *during* the closure of the closest consonant between vowel peaks, so that a portion of that closest consonant is in the first syllable and the other portion in the second syllable. But practically we have to divide before or after such consonants and a certain compromise must be accepted.

On the whole, we applied the principles of syllabication of De Saussure (*Cours de linguistique générale*). They are based on aperture sequences. Consonants fall fairly well into five different degrees of aperture. These five categories nearly coincide with the traditional division by manner of articulation. From smallest to greatest aperture, they are: stops, fricatives, nasals, liquids, and semiconsonants. Thus the abstract syllable "p ʃ ljawrst," with eight consonants and one vowel, is pronounceable because of uninterrupted increasing and decreasing apertures.

According to De Saussure, syllabic division occurs before the closest consonant of an intervocalic series. Thus the French word *patrie* will be divided *pa-trie*, with the consonant group *tr* belonging to the second syllable, since the *t* is of smaller aperture than the *r*. If we reverse the order of the two consonants, as in the word *partie*, the syllabic division takes place between the two consonants: *par-tie*, with the *r* belonging to the first syllable and the *t* to the second. If two consonants are of the same aperture, the division is made between them, as in the word *ac-tif*. One must take care, though, in dealing with languages that have strong consonantal anticipation because they can be at slight variance with these rules.

In both Spanish and French, syllable division was made irrespective of word boundaries within the sense-group, but in English and German, where there is strong consonantal anticipation, we retained word final consonants with the last syllable of the word. Thus in Spanish *el hombre* and in French *il apprend*, the *l* is carried over from the first word to the initial vowel of the second. But in such words as English *in evening* and German *zum einen*, syllable division was made between the two words. If this favored the number of closed syllables in German and English, there was an appropriate compensation in the fact that, within the word, the intervocalic consonant was always counted as belonging to the syllable of the following vowel – *giving*, for instance, was divided *gi-ving* even though such an intervocalic consonant has a larger portion in the first syllable than in the second in a Germanic language as compared to a Romance language.

Another problem presented itself – that of locating the frontier between vowels and consonants on spectrograms. Recent research having shown very clearly that formant transitions are related to the perception of consonants and not to that of vowels, the division was made accordingly – after the transitions in the sequence consonant-vowel, and before the transitions in the sequence vowel-consonant. It is worth noting here that all measurements made in the past on kymograms and oscillograms are obsolete since they counted as part of the vowel everything but the actual consonant closures. The fact is that consonants are perceived, not by their closure portion only, but also, and more, by the opening and closing movements which precede and follow their closure. The arresting and releasing formant transitions, which reflect those closing and opening articulatory movements, are generally sufficient to produce excellent consonants in the synthesis of artificial speech.

Measurements to the closest centisecond having been made, three-by-five cards were prepared for each syllable, to record its phonetic content, its length, its degree of stress, its structural shape in C and V designation, and its position in the sense-group. With this information extracted, tables were drawn up to compare the relation of syllable duration to syllable weight, syllable location, and syllable type among the four languages.

Table 1

Comparison of Syllable Lengths (in cs) under the Effects of Syllabic Weight, Place, and Type

		English	*German*	*Spanish*	*French*
Stressed					
Final	Closed	40.81	36.15	32.13	34.12
	Open	33.45	29.75	24.50	24.57
Non-final	Closed	25.88	24.56	25.88	
	Open	19.19	19.72	20.23	
Unstressed					
Final	Closed	25.62	27.81	23.03	
	Open	21.24	17.69	18.52	
Non-final	Closed	15.50	17.51	19.27	19.19
	Open	12.02	13.22	18.16	13.74

The complete data of syllable length in the four languages under the combined effects of syllable weight (stressed or unstressed), syllable position in the sense-group (final or non-final), and syllable type (closed or open) are gathered here in a single picture. Table 1 shows clearly eight different categories of syllable length in English, German, and Spanish, but only four categories in French, where all stressed syllables are final, and therefore non-final stressed syllables and final unstressed syllables are not found. Many observations could be made with the help of this single table, but because of its complexity, additional tables will be extracted from it, either directly or by further averaging of averages, for each worthwhile comparison among the four languages. Our main purpose, let us recall, is to characterize each of the four languages by comparison with the other three.

There is one remark that can be made only with the help of this general table. The three languages with variable place of stress, English, German, and Spanish, show remarkable agreement of syllable length for stressed non-final syllables.

Where they disagree is in the range of divergence from this common condition to other conditions. Divergence from stressed non-final moves in wide steps in English – upwards to final stressed and downwards to final unstressed and non-final unstressed. The steps in divergence from the non-final stressed condition are less wide in German, and are comparatively narrow in Spanish. Degrees of divergence from a common norm seem to correlate with the ratio of intensity variations between stressed and unstressed vowels. The difference of vowel intensity (measured by over-all amplitude and perceived by loudness) between stressed and unstressed syllables is highest in English (about 4.4 db), less high in German (about 2.2 db), lower in Spanish (about 1.3 db), and lower yet in French (about .5 db in favor of the unstressed syllable). (It is on purpose that this comparison of intensities was made between stressed and unstressed *vowels*, not syllables. Syllable intensity, as was noted earlier, depends not only on vowel amplitude but on several consonant features.)

Table 1-A

Ratios of Syllable Lengths Between Closed Syllables and Open Syllables

		English	*German*	*Spanish*	*French*
Stressed					
Final	Closed / Open	1.22 / 1	1.21 / 1	1.31 / 1	1.39 / 1
Non-final	Closed / Open	1.35 / 1	1.24 / 1	1.28 / 1	
Final	Closed / Open	1.21 / 1	1.57 / 1	1.24 / 1	
Unstressed					
Non-final	Closed / Open	1.29 / 1	1.32 / 1	1.06 / 1	1.40 / 1

If Table 1 shows great divergence among the languages under the effects of syllable weight and syllable position, Table 1-A shows, on the contrary, considerable *similarity* among the languages under the effect of *syllable type*. The ratio of syllable lengths between closed syllable and open syllable in the 14 pairs of figures on Table 1-A is somewhat constant for all conditions and all languages. This ratio is close to 1.30 to 1 in all cases, except for German unstressed final which is higher: 1.57 to 1, and Spanish unstressed non-final which is lower: 1.06 to 1. Statistical data on the consonant to vowel ratio and the proportion of closed

and open syllables tend to support these two exceptions. There are about 1.2 consonants per vowel in German, and only .8 consonants per vowel in Spanish. Closed syllables are in a proportion of 68 percent in German, but only 28 percent in Spanish. (These figures are based on the analysis of 2000 syllables of varied material in German and in Spanish.) This takes care of the negative side. On the positive side, the fact that the ratio of duration between closed and open syllables is nearly constant, no matter how long or how short the syllable is conditioned to be, is an interesting indication that the ratio of time taken by vowels and consonants in a syllable remains somewhat the same under all circumstances in all four languages – if a syllable is longer than another, both its consonants and its vowel are proportionately longer.

Table 2

Maximal Range of Syllable Length Variation
(Combined Effect of Weight, Position, and Type)

	English	*German*	*Spanish*	*French*
Stressed, Final, Closed	40.81	36.15	32.13	34.12
Unstressed, Non-final, Open	12.02	13.22	18.16	13.74
Ratio to 1	3.39	2.73	1.77	2.48

Table 2 presents syllable length averages under the combined effects of syllable weight, syllable position, and syllable type. In other words, this table shows how wide is the maximal range and maximal ratio of syllable length for each of the four languages. On Table 2, as on all following tables, ratios are as indicated just below, and to the right of, the absolute duration averages.

English and Spanish occupy the two opposite ends of the spectrum with respective ratios of 3.39 to 1 and 1.77 to 1 – a very significant difference if we consider that both languages have intensity stress and variable place of stress, and are therefore in the same stress category. Syllable duration emerges as one of the sharpest differences between these two languages.

German and French, with ratios of 2.73 to 1 and 2.48 to 1, are still well distinguished from English and Spanish by their range of syllable length, but they are not distinguished from one another.

Note that in our tables, unstressed syllables comprise all syllables that do not receive the primary stress. If subdivision, for instance into three classes of weak stress, were made, French and Spanish would not be measurably affected, whereas English would show a much wider range of syllable lengths and would be even more distinct from the other languages.

In short, from this table of maximal ranges, syllable length emerges as an important feature in the characterization of languages. One receives very different

rhythmic impressions from languages whose longest syllables (as a class) are about three and a half times longer (English), two and a half times longer (German, French), or one and a half times longer (Spanish) than the shortest syllables (as a class).

Table 3

Overall Effect of Syllable Weight on Syllable Length

	English	*German*	*Spanish*	*French*
Stressed syllable	29.82	27.54	25.68	29.34
Unstressed syllable	18.59	19.06	19.75	16.46
Ratio to 1	1.60	1.44	1.30	1.78

Table 3 presents length averages of all the stressed *vs.* all the unstressed syllables for five minutes of speech in each language. (The category of "unstressed" includes all the syllables that do not receive the primary stress.) The effect of stress on syllable length can be shown either by the difference of length between stressed and unstressed syllables or by the length ratio of stressed to unstressed syllables.

The effect of stress is clearly but not equally marked in all four languages.

Let us first compare the three languages whose place of stress is variable. Of these, English has the widest ratio of syllable lengths from stressed to unstressed. German has a narrower ratio, and Spanish the narrowest. In other words, the contrast of lengths between stressed and unstressed syllables is very sharp in English, somewhat less so in German, and considerably less so in Spanish.

As American teachers of Spanish often state that Spanish syllables are all of nearly equal length, whether stressed or unstressed, it is interesting to note that, according to our data, this is not objectively true – a ratio of 1.30 to 1 is far from negligible. But it is not surprising that, by contrast with his own habits, an American can subjectively estimate Spanish syllables to be of equal length. In fact, as Tables 13 and 17 will show, there are large categories of Spanish syllables whose lengths are not greatly affected by stress or position – unstressed open syllables are hardly longer in final position (18.52) than in non-final position (18.16); and non-final open syllables are only slighter longer in stressed syllables (20.23) than in unstressed syllables (18.16).

Differences of length between stressed and unstressed syllables correlate with differences of vowel intensity. As was noted earlier, in English the difference between stressed and unstressed vowels is, on the average, 4.4 db. In German it is only 2.2 db and in Spanish only 1.3 db. In Spanish, however, the burden of

stressing a syllable is taken over by consonantal features rather than by vocalic ones.

Let us now turn to French, a language whose place of stress is fixed (on the last syllable). It is French which, of the four languages, shows by far the widest ratio of lengths from stressed to unstressed syllables – a ratio of nearly two to one. This can be explained in more than one way. One can note that it is only in French, for instance, that the stressed syllable is always conditioned by both weight and position. When those two factors combine in the other languages, as shown on Table 6, the length ratios are much higher than for either effect.

One can remark also that prominence of the stressed syllable does not rely on an excess of intensity in French, as it does in English, German, and Spanish – the physical intensity of final-syllable vowels, in French, is in fact some 10 percent lower than that of non-final-syllable vowels. In giving prominence to stressed syllables, therefore, duration must take a larger share of the burden than if it were helped by intensity.

Table 4

Overall Effect of Syllable Position on Syllable Length

	English	*German*	*Spanish*	*French*
Final syllable	27.78	27.85	24.54	29.34
Non-final syllable	18.15	18.50	20.88	16.46
Ratio to 1	1.53	1.50	1.17	1.78

Table 4 presents length averages of all the final syllables *vs.* all the non-final syllables for five minutes of speech in each language.

A comparison of Tables 3 and 4 shows that, in English and Spanish, the effect of syllabic position is even stronger than that of stress – the ratios are 1.53 and 1.17 for the effect of position vs 1.60 and 1.30 for the effect of stress. In German, the lengthening effect of position is slightly greater than that for stress; as a result, German final syllables are practically as long, and non-final syllables as short, as English ones – the lengthening effect of syllabic position is very similar. In French the length ratio between final and non-final syllables is the same as between stressed and unstressed syllables since, there also, the effects of weight and position are always the same.

In general, on the basis of these data, one can say that with respect to length the final position is a privileged one in all four languages. Table 8 will show that even unstressed syllables can have considerable length if they are final.

A word can be said here about the effect of the other positions on syllable length. Next in rank is the initial position, which is not so long as the final but

longer than medial positions in all four languages. As to the medial positions, they tend to be longer as they approach the end of the word or the sense-group.

Table 5

Overall Effect of Syllable Type on Syllable Length

	English	*German*	*Spanish*	*French*
Closed syllable	26.94	26.51	25.08	26.65
Open syllable	21.47	20.09	20.35	19.15
Ratio to 1	1.25	1.32	1.23	1.39

Table 5 presents length averages of all the closed syllables *vs.* all the open syllables for five minutes of speech in each language.

On the average, closed syllables are longer than open ones in all four languages, and the ratios of length between closed and open syllables do not differ markedly from one language to another.

If German has a slightly higher ratio than English, and Spanish a slightly lower one, it reflects the respective ratios of consonant to vowel which are 1.2 to 1 in German, 1.0 to 1 in English, and .8 to 1 in Spanish. The slightly higher ratio of syllable lengths in French must be due to the greater number of long syllables in final position, since all final syllables are stressed in French – in final stressed position closing consonants as well as vowels participate in the lengthening or shortening of syllables.

One might have expected to find a rhythmical equalization of syllables irrespective of their closed or open nature. This is not the case. The fact that closed syllables are longer than open ones indicates that there is no clear compensatory effect to prevent the addition of final consonants from lengthening syllables.

Table 6

Combined Effect of Weight and Position in Closed Syllable

	English	*German*	*Spanish*	*French*
Stressed, Final, Closed	40.81	36.15	32.13	34.12
Unstressed, Non-final, Closed	15.50	17.51	19.27	19.19
Ratio to 1	2.63	2.06	1.67	1.78

Table 7

Combined Effect of Weight and Position in Open Syllable

	English	*German*	*Spanish*	*French*
Stressed, Final, Open	33.45	29.75	24.50	24.57
Unstressed, Non-final, Open	12.02	13.22	18.16	13.74
Ratio to 1	2.78	2.25	1.35	1.79

Since Table 5 shows that syllable type has no marked effect in distinguishing one language from another, Tables 6 and 7 eliminate the effect of syllable type and concentrate on the combined effects of weight and position.

Combining the effects of weight and position brings to light the difference between French and the three other languages. French is not affected by this combination of effects. Its ratios between stressed final and unstressed non-final remain the same (1.78 to 1) as they were for stressed *vs.* unstressed or for final *vs.* non-final because, in French, stressed and final are one and the same effect, not two effects that add up.

In the other three languages, the effects of stress and finality add up because a stressed syllable can be either final or non-final and a final syllable can be either stressed or unstressed. Thus in English, German, and Spanish, the range of syllable lengths from stressed final to unstressed non-final is much wider than from stressed to unstressed or final to non-final separately.

In both Tables 6 and 7, the widest ratio is in English, the narrowest is in Spanish, and German is in between. Sharply different ratios distinguish the four languages from one another.

Table 8

Opposed Effects of Weight *vs.* Position in Closed Syllable

	English	*German*	*Spanish*	*Average*
Stressed, Non-final	25.88	24.56	25.88	25.44
Unstressed, Final	25.62	27.81	23.03	25.49
Ratio to 1	1.01	.88	1.12	

Table 9

Opposed Effects of Weight *vs.* Position in Open Syllable

	English	*German*	*Spanish*	*Average*
Stressed, Non-final	19.19	19.72	20.23	19.71
Unstressed, Final	21.24	17.69	18.52	19.15
Ratio to 1	.90	1.11	1.09	

Now, instead of combining the effects of syllable weight and syllable position, we shall oppose them. On Tables 8 and 9, the lengthening effect of stressing is matched with the shortening effect of non-final position, and the shortening effect of unstressing is matched with the lengthening effect of final position. These oppositions disclose that, in the three languages with variable place of stress, some unstressed syllables are, on the average, as long as stressed ones – unstressed syllables that are in final position are nearly as long as, or even slightly longer than, stressed syllables that are not in final position. All oppositions of these two effects produce syllable durations in the neighborhood of 25 centiseconds in closed syllables (Table 8) and 19 centiseconds in open syllables (Table 9). In English, the two effects almost compensate for each other: ratios are 1.01 to 1 in closed syllable and .90 to 1 in open syllable. In German they compensate even more closely: the average ratio of closed and open syllables is .99 to 1. In Spanish, the stressed non-final syllables are but slightly longer than the unstressed final ones: the two ratios average 1.10 to 1.

Naturally, the unstressed final syllables that are as long as stressed non-final ones are not as strong or as loud – they have much weaker consonant and vowel features than the stressed non-final. We can assume that it is because of their low loudness and in spite of their considerable length that unstressed final syllables are perceived as unstressed.

This equivalence of syllable length in unstressed final and stressed non-final indicates that it is only in French that stress is perceived exclusively by an excess of duration. In the three languages with variable place of stress, duration does not function alone – it operates in conjunction with an excess of intensity. Moreover, the fact that all unstressed syllables in the same three languages have weak loudness but not all have short duration indicates that in the perception of stress, loudness is primary and length secondary. (We are aware that in extreme cases duration may be perceived as loudness and intensity as length, but this does not have much bearing on what precedes.)

Let us finally observe the separate effects of weight and position on syllable length in each combination of the two other factors. These data will involve stressed syllables in non-final position as well as unstressed syllables in final

position, and therefore will not concern French – they will only compare among themselves English, German, and Spanish

We shall begin with the effect of syllable position.

Table 10

Effect of Syllable Position on Length of Stressed Closed Syllable

	English	*German*	*Spanish*	*French*
Final, Stressed, Closed	40.81	36.15	32.13	
Non-final, Stressed, Closed	25.88	24.56	25.88	
Ratio to 1	1.58	1.47	1.24	

Table 11

Effect of Syllable Position on Length of Stressed Open Syllable

	English	*German*	*Spanish*	*French*
Final, Stressed, Open	33.45	29.75	24.50	
Non-final, Stressed, Open	19.19	19.72	20.23	
Ratio to 1	1.74	1.51	1.21	

Table 12

Effect of Syllable Position on Length of Unstressed Closed Syllable

	English	*German*	*Spanish*	*French*
Final, Unstressed, Closed	25.62	27.81	23.03	
Non-final, Unstressed, Closed	15.50	17.69	19.27	
Ratio to 1	1.65	1.59	1.19	

Table 13

Effect of Syllable Position on Length of Unstressed Open Syllable

	English	*German*	*Spanish*	*French*
Final, Unstressed, Open	21.24	17.51	18.52	
Non-final, Unstressed, Open	12.02	13.22	18.16	
Ratio to 1	1.77	1.34	1.02	

Tables 10, 11, 12, and 13 show that stressed closed, stressed open, unstressed closed, and unstressed open syllables are all, on the average, longer in final than in non-final position, but always more so in English than in German or Spanish, and more so in German than in Spanish. In other words, syllable position affects syllable duration for every degree of stress and opening, but this conditioning is relatively strong in English, weak in Spanish, and medium in German.

These four tables also show that, under the effect of syllable position, the three languages are better distinguished from each other in open syllables than in closed ones, in unstressed syllables than in stressed ones. Ratios to 1 between final and non-final positions are for English, German, and Spanish, in this order: stressed closed syllables: 1.58, 1.47, 1.24; unstressed open syllables: 1.77, 1.34, 1.02.

The latter data, taken from Table 13, emphasize the fact that the greatest syllabic contrast between English and Spanish is not in stressed syllables but in unstressed ones – English unstressed open syllables are much longer in final position than in non-final position (the ratio is 1.77 to 1), whereas Spanish unstressed open syllables have all nearly equal length, whether they are in final position or not.

Table 14

Effect of Syllable Weight on Length of Final Closed Syllable

	English	*German*	*Spanish*	*French*
Stressed, Final, Closed	40.81	36.15	32.13	
Unstressed, Final, Closed	25.62	27.81	23.03	
Ratio to 1	1.59	1.30	1.39	

Table 15

Effect of Syllable Weight on Length of Final Open Syllable

	English	*German*	*Spanish*	*French*
Stressed, Final, Open	33.45	29.75	24.50	
Unstressed, Final Open	21.24	17.69	18.52	
Ratio to 1	1.57	1.68	1.32	

Table 16

Effect of Syllable Weight on Length of Non-Final Closed Syllable

	English	*German*	*Spanish*	*French*
Stressed, Non-final, Closed	25.88	24.56	25.88	
Unstressed, Non-final, Closed	15.50	17.51	19.27	
Ratio to 1	1.67	1.40	1.34	

Table 17

Effect of Syllable Weight on Length of Non-Final Open Syllable

	English	*German*	*Spanish*	*French*
Stressed, Non-final, Open	21.24	17.69	20.23	
Unstressed, Non-final, Open	12.02	13.22	18.16	
Ratio to 1	1.59	1.49	1.11	

Tables 14, 15, 16, and 17 are concerned with the effect of stress on all positions and types of syllables. They show that final closed, final open, non-final closed and non-final open syllables are all, on the average, longer in stressed than in unstressed position, but generally more so in English than in German or Spanish, and more so in German than in Spanish. In other words, syllabic stress affects syllabic duration for everv position or type of syllable, but this conditioning is relatively strong in English, weak in Spanish, and medium in German.

Again it is of special interest to compare English and Spanish. It is not in final position that those two languages are best distinguished from each other by the degrees of stress, but in non-final position (according to Table 17) – in English, non-final open syllables are much longer when stressed than when unstressed (the ratio is 1.59 to 1), whereas in Spanish, non-final open syllables are only slightly longer when stressed than when unstressed (the ratio is 1.11 to 1).

Now if we compare our observations about Tables 10 to 13 with those about Tables 14 to 17, we are in a position to conclude with more embracing remarks concerning the role of syllable length in the phonetic characterization of languages, and its utility in the teaching of foreign languages.

The degree of stress of non-final syllables and the position of unstressed syllables affect greatly the length of English syllables, somewhat less the length of German syllables, and surprisingly little the length of Spanish syllables. On the matter of syllable length, therefore, we have learned that English, German, and Spanish are maximally distinguished from each other in unstressed and non-final syllables. This is of considerable importance for teaching. The American instructor of those languages must pay much more attention to the articulation of unstressed and non-final syllables than to the stressed and final ones. This, of course, applies even more to French.

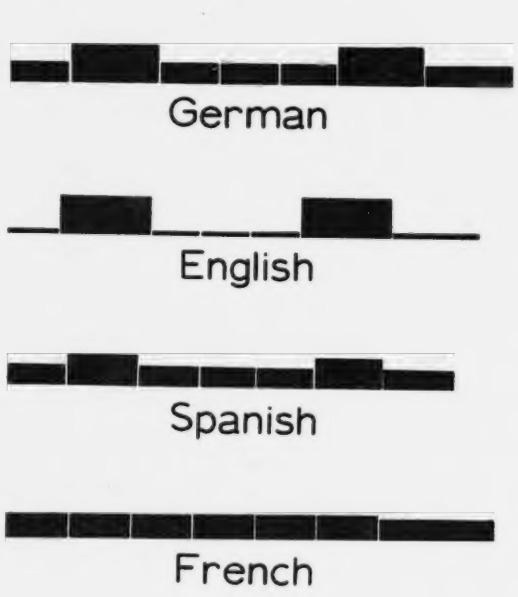

Figure 1: A visual representation of syllable length and vowel intensity variations in German, English, Spanish, and French, under the effects of syllable weight (stressed or unstressed) and syllable position (final or non-final in the sense-group). Durations are neither those of open syllables nor of closed syllables but of the average of the two, based on the following ratios of closed to open: German: 63/37, English: 60/40, Spanish: 28/72, French: 24/76.

To conclude, an attempt is made, in Figure 1, to give a visual representation of the relative syllable durations and vowel intensities of a typical chain of syllables in each of the four languages. Durations are calculated by averaging the closed and the open syllables on the basis of their proportions in each language: in German 63 per cent closed, 37 per cent open; in English 60 per cent closed, 40 per cent open; in Spanish 28 per cent closed, 72 per cent open; in French 24 per cent closed, 76 per cent open. Differences of vowel intensity between stressed and unstressed syllables are based on statistical figures given earlier. Relative to the stressed syllables, the unstressed ones are on the average 4.4 decibels down in English, 2.2 decibels down in German, 1.3 decibels down in Spanish, 0.5 decibels *up* in French. Thus the difference is represented as maximal in English, as 2.2/4.4 as large in German as in English, and as 1.3/4.4 as large in Spanish as in English. It must be kept in mind, however, that vowel intensity alone is not representative of syllable loudness, since consonantal features that are not measurable in decibels also play an important role in the subjective impression of syllable loudness. The role of consonants seems to be unusually strong in Spanish stress, perhaps to compensate for the lack of marked length and intensity differences, as further research may show.

SUMMARY

Comparison of English, German, Spanish, and French syllable-length data is presented in 18 tables and one figure. Those tables show that the effect of stress and of place in the sense-group varies markedly among these languages, whereas the effect of syllable type (closed/open) has a nearly identical ratio in all four. Among the three languages with variable intensity and place of stress, the differences of length between stressed and unstressed syllables are always the widest in English, and the narrowest in Spanish, with German intermediary. The same can be said of differences of length between final and non-final syllables. Vowel intensity variations correlate with syllable length variations in English, German, and Spanish, but not in French, where the vowel of a final stressed syllable is somewhat less intense than that of a non-final unstressed one. In the three languages with variable place of stress, final unstressed syllables are, on the average, as long as – but less loud than – non-final stressed ones.

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